

Appendix C3

C3-1 Chronological List of LNG Accidents

C3-2 Marine Safety and Security Requirements

***C3-3 Design and Safety Standards Applicable
to Natural Gas Projects***



C3-1
CHRONOLOGICAL LIST OF LNG
ACCIDENTS

CHRONOLOGICAL LIST OF LNG ACCIDENTS

Major LNG Incidents								
No.	Incident Date	Ship/Facility Name	Location	Ship Status	Injuries/Fatalities	Ship/Property Damage	LNG Spill/Release	Comment
1	1944	East Ohio Gas LNG Tank	Cleveland, Ohio, US	NA	128 deaths	NA	NA	LNG peakshaving facility. Tank failure and no earthen berm. Vapor cloud formed and filled the surrounding streets and storm sewer system. Natural gas in the vaporizing LNG pool ignited. Stainless steel alloys were scarce because of World War II; tank was made of a low-nickel content (3.5%) alloy steel.
2	1965	LNG import facility	Canvey Island, UK	A transfer operation	1 seriously burned		Yes	Small amount of LNG spilled from a tank during maintenance; spill ignited.
3	1965	Jules Verne	Arzew, Algeria	Loading	No	Yes	Yes	Overfilling. Tank covered and deck fractures.
4	1965	Methane Princess		Disconnecting after discharge	No	Yes	Yes	Valve leakage. Deck fractures.
5	1966	Methane Progress		NA	NA	NA	Yes	Cargo leakage reported.
6	1968	LNG peakshaving facility	Portland, Oregon, US	NA	4	NA	No	Unfinished LNG storage tank. Natural gas from a pipeline being pressure tested inadvertently entered the tank as a result of improper isolation, and then ignited causing an explosion. Neither the LNG tank nor the process facility had been commissioned at the time the accident occurred; thus, the tank had never contained any LNG.

Major LNG Incidents								
No.	Incident Date	Ship/Facility Name	Location	Ship Status	Injuries/Fatalities	Ship/Property Damage	LNG Spill/Release	Comment
7	1968	Aristotle	Mexico	NA	NA	Yes	No	Ran aground and the bottom was damaged, possibly during LPG service.
8	1969	Polar Alaska		NA	NA	No	No	Sloshing of the LNG heel in No. 1 tank caused part of the supports for the cargo pump electric cable tray to break loose, resulting in several perforations of the primary barrier. LNG leaked into interbarrier space.
9	1970	Arctic Tokyo		NA	No	Yes	No	Sloshing of the LNG heel in No. 1 tank during bad weather caused local deformation of the primary barrier and supporting insulating boxes. LNG leaked into the interbarrier space at one location.
10	1971	LNG ship Esso Brega, La Spezia LNG Import Terminal	Italy	Unloading LNG into the storage tank	NA	NA	Yes	First documented LNG rollover incident. Tank developed a sudden increase in pressure. LNG vapor discharged from the tank safety valves and vents. Tank roof slightly damaged. No ignition.
11	1971	Descartes		NA	NA	No	No	A minor fault in the connection between the primary barrier and tank dome allowed gas into the interbarrier space.

Major LNG Incidents								
No.	Incident Date	Ship/Facility Name	Location	Ship Status	Injuries/Fatalities	Ship/Property Damage	LNG Spill/Release	Comment
12	1972	Gaz Métropolitain LNG peakshaving facility	Montreal East, Quebec, Canada	NA	NA	NA	Although an LNG facility, LNG was not involved	The accident occurred in the control room due to a backflow of natural gas from the compressor to the nitrogen line. Nitrogen was supplied to the recycle compressor as a seal gas during defrosting operations. The valves on the nitrogen line were not closed after completing the operation. This resulted in the overpressurization of the nitrogen header, and the instruments vented their contents into the control room where operators were allowed to smoke. The explosion occurred while an operator was trying to light a cigarette.
13	1973	Texas Eastern Transmission, LNG Tank	Staten Island, NY, US	NA	40 killed	No	No	Industrial incident unrelated to the presence of LNG (construction incident). During the repairs, vapors associated with the cleaning process apparently ignited the mylar liner. Fire caused temperature in the tank to rise, generating enough pressure to dislodge a 6-inch thick concrete roof, which then fell on the workers in the tank.
14	1973		Canvey Island, UK	NA	No	Yes	Yes	Glass breakage. Small amount of LNG spilled upon a puddle of rainwater, and the resulting flameless vapor explosion, called a rapid phase transition (RPT), caused the loud "booms". No injuries resulted.
15	1974	5,000 m ² Barge Massachusetts		Loading	No	Yes	Yes	Valve leakage after power failure. USCG found that a pressure surge caused the leakage of about 40 gallons of LNG. Deck fractures.
16	1974	Methane Progress		In port	No	Yes	No	Touched bottom at Arzew.

Major LNG Incidents								
No.	Incident Date	Ship/Facility Name	Location	Ship Status	Injuries/Fatalities	Ship/Property Damage	LNG Spill/Release	Comment
17	1974	Euclides		In port	No	Yes	No	Ran aground and damaged bottom and propeller. In another incident, minor damage occurred due to contact with another vessel.
18	1974	Methane Princess			No	Yes	No	While moored, rammed by freighter Tower Princess resulting in 3-foot gash in hull.
19	1975	Philadelphia Gas Works		NA	No	Yes	NA	Not caused by LNG. An iso-pentane intermediate heat transfer fluid leak caught fire and burned the entire vaporizer area.
20	1977	LNG export facility at Arzew	Algeria	NA	1 worker frozen to death	NA	Yes	Aluminum valve failure on contact with cryogenic temperatures. Wrong aluminum alloy on replacement valve. LNG released, but no vapor ignition (LNG liquefaction facility). The current practice is to provide valves in LNG service that are made with stainless steel.
21	1977	LNG Aquarius		Loading	No	No	Yes	Tank overfilled.
22	1978	LNG export facility	Das Island, United Arab Emirates	NA	No	No	Yes	A bottom pipe connection of an LNG tank failed resulting in a spill inside the tank containment. The liquid flow was stopped by closing the internal valve, and a large vapor cloud resulted and dissipated without ignition.
23	1978	Khannur	Strait of Singapore	NA	No	Yes	No	Collision with cargo ship Hong Hwa.

Major LNG Incidents								
No.	Incident Date	Ship/Facility Name	Location	Ship Status	Injuries/Fatalities	Ship/Property Damage	LNG Spill/Release	Comment
24	1979	Columbia Gas LNG import terminal	Cove Point, Maryland, US	NA	1 killed, 1 seriously injured	Yes	Yes	An explosion occurred within an electrical substation. LNG leaked through LNG pump electrical penetration seal, vaporized, passed through 200 feet of underground electrical conduit, and entered the substation. Since natural gas was never expected in this building, there were no gas detectors installed in the building. The normal arcing contacts of a circuit breaker ignited the natural gas-air mixture, resulting in an explosion. Building codes pertaining to the equipment and systems downstream of the pump seal were subsequently changed.
25	1979	Mostefa Ben-Boulaid Ship	Cove Point, Maryland, US	Unloading	No	Yes	Yes	Valve leakage. Deck fractures.
26	1979	Pollenger Ship	Distrigas terminal, Everett, Massachusetts	Unloading	No	Yes	Yes	Valve leakage. Tank cover plate fractures.
27	1979	El Paso Paul Kayser Ship	Strait of Gibraltar	At sea	No	Yes	No	Stranded. Severe damage to bottom, ballast tanks, motors water damaged, bottom of containment system set up.
28	1980	LNG Libra		At sea	No	Yes	No	Shaft moved against rudder. Tail shaft fractured.
29	1980	LNG Taurus	Ran aground near Tobata, Japan	In port	No	Yes	No	Stranded. Ballast tanks all flooded and listing. Extensive bottom damage.

Major LNG Incidents								
No.	Incident Date	Ship/Facility Name	Location	Ship Status	Injuries/Fatalities	Ship/Property Damage	LNG Spill/Release	Comment
30	Early 1980s	El Paso Consolidated		NA	NA	Yes	Yes	Minor release of LNG from a flange. Deck plating fractured due to low temperature embrittlement.
31	Early 1980s	Larbi Ben M'Hidi		NA	NA	No	No	Vapor released during transfer arm disconnection.
32	1983	Norman Lady	Sodegaura, Japan	Prior to unloading	Not reported	Not reported	Yes	During cooldown of the cargo transfer arms, the ship moved astern under its own power. All cargo transfer arms sheared and LNG spilled. No ignition.
33	1983	LNG export facility	Bontang, Indonesia	NA	Yes, 3 workers	Yes	No	Liquefaction column (large vertical, spiral-wound heat exchanger) ruptured due to overpressurization caused by a blind flange left in a flare line during startup. Debris and coil sections were projected.
34	1984	Melrose		At sea	No	Yes	No	Fire in engine room. No structural damage sustained – limited to engine room.
35	1985	Gradinia		In port	No	Not reported	No	Steering gear failure. No details of damage reported.
36	1985	Isabella		Unloading	No	Yes	Yes	Cargo valve failure. Cargo overflow. Deck fractures.
37	1985	Annabella		NA	NA	NA	Yes	Reported as “pressurized cargo tank.” Presumably, LNG released from the tank or piping.
38	1985	Ramdane Abane		NA	NA	Yes	No	Collision while loaded. Port bow affected.
39	1985	LNG peakshaving facility	Pinson, Alabama US	Unloading	Yes	Yes	Yes	The welds on a “patch plate” on a aluminum vessel failed as the vessel was receiving LNG which was being drained from the liquefaction cold box. The plate was propelled into a building that contained the control room, boiler room, and offices.

Major LNG Incidents								
No.	Incident Date	Ship/Facility Name	Location	Ship Status	Injuries/Fatalities	Ship/Property Damage	LNG Spill/Release	Comment
								Some of the windows were blown inward and natural gas escaping from the vessel entered the building and ignited, injuring six employees.
40	1989	Tellier		Loading	No	Yes	Yes	Broke moorings. Hull and deck failures.
41	1989	LNG peakshaving facility	Thurley, United Kingdom	Unloading	Yes	Yes	Yes	While cooling down vaporizers in preparation for sending out natural gas, low-point drain valves were opened. One of these valves was not closed when pumps were started and LNG entered the vaporizers. LNG was released into the atmosphere and the resulting vapor cloud ignited, causing a flash fire that burned two operators.
42	1990	Bachir Chihani		At sea	No	Yes	No	Sustained structural cracks allegedly caused by stressing and fatigue in inner hull.
43	1992	LNG peakshaving facility	Baltimore, MD, US	NA	No	Yes	Yes	A relief valve on LNG piping failed to open and released LNG into the LNG tank containment for over 10 hours, resulting in loss of over 25,000 gallons into the LNG tank containment. The LNG also caused embrittlement fractures on the outer shell of the LNG tank. The tank was taken out of service and repaired.
44	1993	Indonesian liquefaction facility	Indonesia	NA	No	NA	NA	LNG leak from open run-down line during a pipe modification project. LNG entered an underground concrete storm sewer system and underwent a rapid vapor expansion that overpressured and ruptured the sewer pipes. Storm sewer system substantially

Major LNG Incidents								
No.	Incident Date	Ship/Facility Name	Location	Ship Status	Injuries/Fatalities	Ship/Property Damage	LNG Spill/Release	Comment
								damaged.
45	1997	Northwest Swift	400 km from Japan	NA	NA	Yes	No	Collided with a fishing vessel and sustained damage to hull, but no ingress of water.
46	1997	LNG Capricorn	Japan	NA	NA	Yes	No	Struck a mooring dolphin and sustained damage to hull but no ingress of water.
47	1999	Methane Polar		NA	No	Yes	No	Engine failure during approach to Atlantic LNG jetty. Struck and damaged Petrotrin pier.
48	2000	LNG import terminal	Savannah, Georgia, US	NA	No	Yes	No	In September 2000, a 580-foot ship, the Sun Sapphire, lost control in the Savannah River and crashed into the LNG unloading pier at Elba Island. The Elba Island facility was undergoing reactivation but had no LNG in the plant. The Sun Sapphire suffered a 40-foot gash in her hull. The point of impact at the terminal was the LNG unloading platform. The LNG facility experienced significant damage, including the need to replace five 16" unloading arms.
49	2002	LNG ship Norman Lady	East of the Strait of Gibraltar	At sea	No	Yes	No	Collision with a U.S. Navy nuclear-powered attack submarine, the U.S.S Oklahoma City. In ballast condition. Ship suffered a leakage of seawater into the double bottom dry tank area.
50	2004	Trinidad,		NA	No	Yes	NA	Workers were evacuated after a gas

Major LNG Incidents								
No.	Incident Date	Ship/Facility Name	Location	Ship Status	Injuries/Fatalities	Ship/Property Damage	LNG Spill/Release	Comment
		Tobago						turbine at Atlantic LNG's Train 3 facility exploded.
51	2004	Skikda I	Algeria	NA	27 killed 72 injured (The casualties are mainly due to the blast, few casualties due to fire)	NA	NA	On January 19, 2004: No wind, semi-confined area (cold boxes, boiler, control room on 3 sides). The fire completely destroyed the train 40, 30, and 20, although it did not damage the loading facilities or three large LNG storage tanks also located at the terminal. Explosion due to a confined gas leak and ensuing fireball. FERC and DOE joint report indicated that there were local ignition sources, a lack of 'typical' automatic equipment shutdown devices, and a lack of hazard detection devices.
52	2006	Train 2 facility	Port Fortin, Trinidad, Caracas	NA	1 injured	No	Yes	Atlantic LNG reported that an accident occurred at its Train 2 facility at Point Fortin, Trinidad when a temporary eight-inch isolation plug was blown by built-up pressure. The Train 2 facility had been shut down due to the detection of a gas release from a two-inch pipeline. The release of natural gas was brought under control, and personnel returned. While the company was carrying out repairs the plug blew injuring one worker. It had been filled with inert gas to facilitate repairs.

Sources: University of Houston, "LNG Safety and Security," October 2003. <http://www.beg.utexas.edu/energyecon/lng/>. Cited with permission; Sonatrach, "The Incident at the Skikda Plant: Description and Preliminary Conclusions", March 2004; USCG, The Coast Guard Journal of Safety at Sea Proceedings of the Marine Safety & Security Council, Liquefied Natural Gas, Ensuring its safe and secure marine transportation, "Accidents, Incidents, Mistakes, and the Lessons Learned from Them," Fall 2005; CH IV International, Safety History of International LNG Operations, Technical Document TD-02109February 2006. Oil and Gas International, "Atlantic LNG Trinidad Train 2 accident injures employee," November 2006, <http://www.oilandgasinternational.com/default.aspx>.

C3-2
MARINE SAFETY AND SECURITY
REQUIREMENTS

MARINE SAFETY AND SECURITY REQUIREMENTS

1 Structural Safety Features of the FSRU

Some of the major safety features of the FSRU required that would reduce the likelihood of an accidental cargo release and would mitigate any release, regardless of cause are listed in the following table.

Safety Feature	Description
Double Hull Construction	The FSRU and LNG carriers would be constructed with an outer and inner hull to provide protection against collisions and resultant cargo loss. These hulls are separated from each other by structural members and separated from the Moss spherical tanks by the tank mounts. Thus a collision would need to penetrate three layers to result in cargo spillage.
Separation of cargo holds and piping systems	IGC code requires the structural separation of cargo holds from other spaces, as well as separation of cargo piping from other piping systems. Amongst other things, this helps keep cargo leaks away from potential ignition sources and keeps cargo from inadvertently being pumped through the wrong pipes.
Accessibility for Inspection Access	IGC code requires that a tank be constructed so that at least one side is visible and accessible to inspectors. This allows proper periodic inspection of the tank for integrity and signs of corrosion or stress.
Leak Detectors in Hold spaces	IGC code requires that gas detectors and low temperature sensors be placed in a cargo hold in order to cargo leakage. An alarm sounds if either is detected and appropriate repairs and precautions can be undertaken.
Tank Requirements for Cargo Containment	IGC code requires that a tank be constructed with materials that can withstand the temperatures involved so as to properly contain the cargo, and have adequate relief valve systems to avoid over pressurization.
Structural Analysis	IGC code requires structural analysis of the cargo containment system and specifies individual tank stress limitations.
Secondary containment and thermal management	IGC code requires partial secondary containment to contain leaks and prevent contact of cryogenic liquid with the inner hull. This prevents thermal stress. In addition, insulation in conjunction with a primary and backup heating system must be installed that would keep the cargo from exceeding the thermal limitations of the material selected for the inner hull should the leak prevention system fail.
Tank Construction and Testing Requirements	IGC codes address standards for workmanship, quality, and testing of tanks under construction. Each tank on the FSRU will have had its welds non-destructively tested, and have had a pressure test to insure integrity before cargo is pumped aboard.
Isolation, Construction and Testing Requirements for Piping and Pressure Vessels	IGC code specifies piping thickness, leak testing, pressure testing, isolation requirements, welding requirements and many other aspects of pressure vessel and piping design and construction. This insures the integrity of these systems before any cargo is brought aboard.
Emergency Shutdown Valves and Shutdown Systems	IGC code requires remote control shutdown systems for ceasing of cargo and vapor transfer in an emergency. This system must have the ability to be activated from at least two locations on board the FSRU and will also be automatically activated in the event of a cargo fire.

Safety Feature	Description
Pressure Venting Systems	IGC code specifies that appropriate venting of the cargo be installed to keep the cargo under the design pressure of the tank and keep relief valves from needing to operate. The FSRU will use some of this gas for fueling the Submerged Combustion Vaporizers, and will add the rest to the gasified product being pumped to shore.
Vacuum Protection Systems	IGC code requires the installation of relief valves that would prevent under pressurization of cargo tanks in the event that cargo was pumped out without adequately providing for vapor return. The FSRU will have sufficient vapor return capacity to keep the pressures at appropriate levels, however this system will prevent under pressurization should this system fail to be actuated or fail to work properly.
Fire Protection Systems	IGC code requires that LNG carriers have a saltwater fire main system for fighting fires throughout the ship, and fixed dry chemical and CO2 systems for cargo areas and compressor rooms, respectively.
Cargo Tank Instrumentation	IGC code requires that each cargo tank be outfitted with an integrated instrumentation/alarm system that notifies the crew of possible leaks via gas detection and temperature sensors; and tank liquid levels, temperatures and pressures. These systems, as well as the pressure relief systems mentioned above, provide many-layered protection against cargo release either through equipment malfunction or human error.
Additional Gas Detection Systems	IGC code also requires gas detection systems and alarms in spaces where cargo is located, including compressor spaces, spaces where fuel gas is located, and other spaces likely to contain gasified cargo. Venting systems for certain spaces and portable gas detectors are also required.
Automatic Safety Shutdown Systems	IGC code requires that cargo loading areas and the docks be equipped with LNG vapor and fire detection systems that automatically shut down the transfer systems in the event of a leak or fire. These shutdowns can also be manually operated by personnel on the dock (in this case, the FSRU) or LNG carrier.
Loading Arm Emergency Release Couplings	The FSRU loading arms are designed to isolate the flow of cargo and break away from their connection to the carrier if relative motion exceeds safety parameters. This prevents damage to the arms, and averts the spill of cargo which would result from a broken arm. Quantities spilled during this process would be only a few gallons, most of which would be caught in drip trays to prevent deck thermal damage.

2 Operational Measures for Accidental Release Prevention

In addition to the design regulations described above, the international and national entities with authority to impose such regulations have also provided operational guidelines to reduce the likelihood and impact of an LNG release aboard carriers. The FSRU, as a Deepwater Port of the United States, is primarily guided by the Deepwater Port Act as modified in 33 CFR 148 - 150 by the Maritime Safety and Security Act and other legislation and agency determinations.

These measures include:

- Training,
- Formal Operational Procedures, and
- Inspections.

2.1 Training

Training requirements for crews of LNG carriers are specified in the IMO STCW Convention and those for the FSRU are detailed in 33 CFR 150. A wide variety of training is included for both, including marine firefighting, water survival, spill response and clean-up, emergency medical procedures, hazardous materials procedures, confined space entry, and training on operational procedures. Specifics are also included in the below summary of the Deepwater Port Operations Manual requirements.

2.2 Formal Operational Procedures

Both the FSRU and the visiting LNG carriers would be required to have formal operating plans that cover an extensive array of operational practices and emergency procedures. LNG carriers are required by the IMO to meet the ISM Code, which addresses preparing for responding to emergency situations like fire and LNG releases. The LNG carrier's navigational, pollution response, and some emergency procedures would also be covered in the Deepwater Port Operations manual, which addresses every aspect of the FSRU operations. The minimum contents of this manual are detailed in 33 CFR 150. This manual provides detailed requirements that cover contingencies and normal operations. The operations manual must meet all requirements set forth by the US Coast Guard, and be approved by that organization before operations begin.

The operations manual is required by 33 CFR 150 to address the following areas:

- The DWP facilities must be clearly described physically and geographically, applicable codes for design and construction must be detailed, schematics of all systems must be included which show the positions of all operations and safety equipment. The communications system must be described and communications procedures laid out.
- Procedures for the visiting LNG carriers are also required to be included. Operating hours must be set and sizes and types of tankers that may be received must be described. Navigation standards for the LNG carriers must be set forth, including operating limits for each type of carrier. Speed limits for the safety zone must be specified, as well as the means of tracking, communicating and giving routing instructions to the carriers. Required notices that carriers must give prior to arrival must be detailed. Rules for navigating in the safety zone and for mooring/unmooring must be detailed. Special equipment needed for mooring or navigating must be described. Procedures for clearing all carriers and support vessels away from the FSRU in the event of an emergency or for normal operations must be specified.
- Weather forecasting and information dissemination procedures must be set forth. Specific weather limitations must be defined for carrier arrival, cessation of cargo transfer operations and departure of carriers from moorings in the event of adverse weather being forecasted or as it occurs unexpectedly. This includes defining conditions in which the FSRU would be secured and evacuated.

- The manning requirements for all operational and emergency situations must be specifically described, with personnel in charge of major evolutions designated by name, in writing. The supervisors would be reviewed by the US Coast Guard to ensure they have the proper qualifications and training to perform their duties.
- Procedures for major evolutions, such as cargo transfers, must be set forth in detail. Manning and training requirements, specific duties for watchstanders and supervisors and emergency shutdown system settings must be detailed. Special precautions and handling procedures for LNG must be included.
- Maintenance program requirements and specific procedures are required to document the service and repair of cargo equipment, fire fighting systems, safety equipment and cranes.
- Occupational Health and Safety training procedures and requirements must be detailed, including: housekeeping, illumination requirements, fall arrest equipment, personnel transfer systems, hazard communication, permissible exposure limits for hazardous substances, protective guards around machinery, electrical safety, lockout/tagout procedures, crane safety, sling usage, hearing conservation, hot work, warning sirens, and confined space entry.

The security plan is part of the operations manual and is covered in detail in the below security section.

An environmental monitoring program also must be included, which describes procedures for monitoring the effects of the port on its surroundings. This must include periodic re-examination of the physical, chemical and biological factors examined in the Environmental Impact Statement, as well as air and water monitoring proscribed by other statutes and state law. Detailed studies are required in the event of a spill.

2.3 Inspections

The US Coast Guard has the authority and jurisdiction to perform inspections of Project vessels in U.S. waters, or on the high seas after a vessel states intent to moor at the DWP. Additional inspections may be carried out on LNG carriers by their flag states, by classification societies, and by the owners. Per 33 CFR 150, the US Coast Guard also may inspect the FSRU at any time, with or without notice, for safety, security, and compliance with applicable U.S. laws and regulations.

33 CFR 150 mandates that the FSRU be self inspected every 12 months by the owner or operator to ensure compliance with applicable safety and security laws and regulations. The results must be reported to the US Coast Guard COTP within 30 days of completion, and may be checked for accuracy by a Coast Guard inspection at any time. This report must include descriptions of any failure, and the scope of repairs subsequently made. Any classification society certification or interim class certificate must be reported to the COTP as well.

The US Coast Guard has marine inspection programs for ships, Outer Continental Shelf structures, DWP Facilities and waterfront facilities. US Coast Guard Officers and Petty Officers receive very detailed training on applicable regulations and inspection techniques. For this project, the most applicable Safety programs include the Port State Control program and 33

CFR 160 for the inspection and routing of visiting ships, and the DWP inspection program specified by 33 CFR 150.

Ports State Control of visiting vessels occurs by means of a US Coast Guard Boarding, targeted at determining the vessels compliance to international IMO standards for safety, pollution control, loading, and watch stander qualification, training and procedures. Vessel safety, sanitation and cargo handling equipment is inspected, emergency drills and procedures may be ran in order to determine crew proficiency, navigation practices are examined, and all pertinent plans, safety management systems and other required documents are examined. The required 96-hour Notice of Arrival for these vessels allows the Coast Guard ample time to determine which vessels to board, whether to conduct the boarding in port or at sea, or even if entry is denied pending an inspection.

The COTP decides which vessels are at highest risk for non-compliance with IMO conventions through a process by which the following factors are considered: The owner, Flag State and classification society of the vessel - some owners, flag states and classification societies have a history of poor inspection and regulation of their vessels; how many times and how recently a vessel has been boarded or detained for violations previously; and the type of cargo the vessel is carrying. The vessels having the most factors of concern are boarded immediately, while others may be boarded on subsequent entries into the U.S.

Vessels found to be in non-compliance with IMO standards may be recommended for further flag state or classification society audit, detained in port until their discrepancies are fixed, ordered to anchorage for the same purpose, or forbidden to enter U.S. waters.

33 CFR 160 gives authority to each US Coast Guard District Commander or Captain of the Port to order a vessel to operate or anchor in the manner directed when there is a suspected violation of law or treaty, there is a failure to satisfy the cargo transfer provisions of 33 CFR160.113, or if justified by weather, visibility, port congestion or condition of the vessel.

33 CFR 160.113 Gives COTP the authority to prohibit a vessel from transferring cargo or operating on the navigable waters of the US if the vessel's history of accidents, pollution incidents, or serious repair problems creates reason to believe that the vessel may be unsafe or pose a threat to the marine environment. It also allows these restrictions for other reasons: The vessel is in violation of a law or regulation, has discharged oil or other hazardous substance in violation of US law or treaty, fails to comply with Vessel Traffic Service requirements, or does not have at least one licensed deck officer on the navigation bridge that speaks English.

One of the relevant results of this inspection regimen is that every Project vessel and the FSRU would be inspected at least yearly for compliance to all applicable IMO standards and U.S. laws. Equipment, training, qualifications, operating and emergency procedures, administrative controls, and most every other aspect leading to safe operation of the FSRU and project vessels would be checked by the owners, the flag states (for vessels) and the United States for compliance.

3 Security Measures that Help Prevent Release Incidents Due to Deliberate Attacks

Regulation and operational procedures play a vital role in the prevention of terrorist acts. In fact, much of what prevents or mitigates an accident will do the same for a terrorist act (double hulls, fire suppression systems, etc). However, potential deliberate acts of terrorism expose the Project to new threats, many of which cannot easily be prevented, though mitigative actions may be nearly the same after the incident occurs.

The foundation for the FSRU and visiting LNG carriers' security would be the requirements for a security plan outlined in 33 CFR 150. This plan would address security issues including, but not limited to:

- Access control for people, goods and material;
- Monitoring and alerting vessels that approach or enter the ports security zone;
- Identifying risks and measures to deter terrorist activity;
- Internal and external notification requirements and responses in the event of a perceived threat or attack on the port;
- Designating a Port Security Officer; providing identification means for port personnel; security training requirements;
- Actions and procedures that are scalable to the threat; emergency procedures such as evacuation; special operations procedures (re-manning, refueling, diving, support vessel operations and logistical concerns);
- Recordkeeping for maintenance; and
- Tests and operations outlined in the operations manual.

In addition, radar monitoring of the security zone is required when any vessel approaches or enters the zone. Such vessels must be identified and warned off via radio.

3.1 Requirements to meet IMO's International Ship and Port Facilities Security Code (ISPS) Code

IMO's ISPS code has the following additional requirements:

- Security levels;
- Ship security plans;
- Ship security alarm systems;
- Automatic identification systems;
- Port security plans;
- Declarations of security; and
- Facility security plans.

For the U.S., these IMO requirements are addressed in 33 CFR Subchapter H—Maritime Security.

3.1.1 Security levels

For the U.S., security levels are covered in 33 CFR 101, which ties the three tiered Maritime Security (MARSEC) level to the five level Department of Homeland Security's Homeland Security Advisory System as the below table depicts.

Homeland security advisory system (HSAS) threat condition		Equivalent maritime security (MARSEC) level
Low:	Green	MARSEC Level 1.
Elevated:	Blue	
Guarded:	Yellow	
High:	Orange	MARSEC Level 2.
Severe:	Red	MARSEC Level 3.

Specific actions would be required of Project personnel at each level, and would be detailed in the security plan for the FSRU and the Ship Security plans.

Changes in MARSEC level is communicated by the COTP via Broadcast NTM, and all who are required to have a security plan (facilities, vessels must report attainment of measures in their plan that correspond to the new MARSEC level to the appropriate Coast Guard District Commander.

When the USCG determines it is necessary to enact additional measures to counter a maritime threat, the USCG Commandant (or delegate) may issue a directive to those required to have a security plan (or portions of, as needed) to take additional security measures to counter the threat. Reporting of attainment of the measure or its approved equivalent is carried out in the same way as a change in MARSEC, but within a time period specified by the directive.

3.1.2 Vessel security plans

33 CFR 104 requires every vessel owner or operator who operates in U.S. waters to develop and submit to USCG a vessel security plan. The regulations provide the format and requirements for the plan. Vessel security plan implementation must be evaluated by an onboard verification by the flag state or a security organization recognized by the flag state before an International Ship Security Certificate (ISSC) can be issued for that vessel. These plans must include provisions for access to the ship by ship personnel, passengers, visitors, etc; restricted areas on the ship; handling of cargo; delivery of ship's stores; handling unaccompanied baggage; and monitoring the security of the ship. These measures are intended to prevent deliberate destructive act on board a vessel and the possible hijacking of the vessel for use as a weapon (ramming other vessels, bridges, blocking channels, releasing cargo near shore, etc).

Control and compliance measures for those vessels in violation of this requirement include the vessel's inspection, delay or detention. Vessel operations may be restricted, port entry into the U.S. denied, or the vessel may be expelled from a U.S. port. Lesser administrative or corrective actions may be taken. The vessel's security plan is subject to USCG approval, which may be withdrawn, which would make it illegal for the vessel to operate in, on, under or adjacent to U.S. waters.

3.1.3 Ship security alarm systems

Ship security alarm systems are required by the ISPS code for Project LNG carriers. These systems are manually operated by the crew in the event of a terrorist destructive act or attempted takeover. An alarm does not sound on the vessel, but does automatically send a signal to appropriate authorities, such as the Coast Guard.

3.1.4 Automatic identification systems (AISs)

As described in the above vessel collision avoidance section, an AIS provides augmented data to radar users, which aid in the identification of vessels. The traffic controllers onboard the FSRU, the VTS and USCG responders would be able to locate and identify vessels outfitted with AIS more quickly and accurately, thus decreasing confusion and response time to an emergency, including security alarm activations.

3.1.5 Port security plans

The ISPS Code requires ports to have a port facility security officer and to develop a port facility security plan which must interface with the individual vessel security plans. In the United States, 33 CFR 103 mandates an Area Maritime Security plan which applies to all vessels and facilities located in, on, under, or adjacent to waters subject to U.S. jurisdiction. This regulation empowers the COTP to set up counsels to advise on port security, write and exercise the area security plan and defines required elements of the plan. (ex. Plan must address actions to be taken for a change of MARSEC, what to do if a vessel security alert system is activated, estimated response and timeframe for a Transportation Security incident, etc)

3.1.6 Declarations of security

Declarations of security are required by 33 CFR 101 for ports across the US, and are intended to serve as the formal means by which the security actions of the vessel and port are agreed upon during mooring and cargo transfer operations. This declaration must be signed by the vessel and facility security officer prior to commencement of offloading.

3.1.7 Facility security plans

Under the USCG maritime security regulations (33 CFR 105 Subpart D), LNG facilities that receive LNG carriers will have to develop a facility security plan. Like the vessel security plans that have to meet the ISPS Code, the USCG regulations define areas the facility security plans have to address, including:

- Security administration and organization of the facility;
- Personnel training;
- Drills and exercises;
- Records and documentation;
- Response to change in security level;
- Procedures for interfacing with vessels;
- Declaration of Security;
- Communications;
- Security systems and equipment maintenance;
- Security measures for access control, restricted areas, handling cargo, delivery of vessel stores and bunkers, and monitoring;

- Security incident procedures; and
- Audits and security plan amendments.

Like ship security plans, USCG must approve facility security plans. If the COTP deems a waterfront facility unsafe or insecure in any way by, vessels may be prevented from docking there, or be moved if already docked.

Other, control and compliance measures for facilities for violations of these requirements include restriction on facility access, conditions being put on facility operations, suspension of operations, or revocation of approval for the facility's security plan which makes it illegal for the facility to operate.

3.1.8 Coast Guard operational measures applicable to security of the Project

The USCG, in addition to its inspection duties, is also an active enforcer of all applicable national and international law on the high seas and within the waters of the United States. The USCG's enforcement of these laws will significantly add to the security of any nearby facility. These actions may include:

- Enforcement of 96-hour Notice of Arrival (NOA) requirements, including vetting crew and passenger lists against terrorist and criminal databases.
- Conducting regular patrols with aircraft and armed surface vessels to support Maritime Domain Awareness (knowing what vessels are within or near U.S. waters).
- Conducting Right of Approach questioning of any vessel to determine country of registry, last port of call, crew nationality and other useful data.
- Conducting background intelligence checks on sighted vessels and like checks on the crews of boarded vessels.
- Monitoring all vessel traffic over 300 GWT with 25 NM of Pt. Fermin Light as part of VTS LA/LB (Note: this area is approx 5nm from the FSRU and covers approaches from the West).
- Conducting armed escorts of vessels deemed to be High Risk.
- Placing Armed Sea Marshals on board High Risk vessels (Note: the determination to provide escort or Sea Marshals for any Project vessel is at the discretion of COTP).
- Conducting searches of vessels suspected of violating immigration, customs and narcotics laws.
- Inspecting the safety gear of all U.S. flagged and state registered pleasure craft and commercial vessels.
- Conducting searches of foreign vessels with flag state or Master's consent for evidence of violation of applicable laws.
- Acting in accordance with the U.S. Military Standing Rules of Engagement to protect U.S. citizens and property.
- Patrolling, warning and boarding vessels to enforce security zones.

Should the threat level or other circumstance dictate, the USCG and other military branches would take measures to provide for the security of the Project. The nearby presence of military vessels and aircraft conducting operations and surveillance of the Point Mugu Sea Range would also augment Maritime Domain Awareness, and would periodically result in the presence of armed warships within relatively close proximity to the FSRU. All of these vessels could be hailed on frequencies available in the FSRU communications centers, and all are allowed by the rules of engagement to protect themselves, other U.S. military units, U.S. Citizens and property if being attacked.

The COTP may restrict anyone, or anything from entering a waterfront facility subject to U.S. jurisdiction or boarding a vessel subject to U.S. jurisdiction deemed necessary for safety or security. Further, to prevent damage or injury to vessels or facilities or safeguard ports, territory, or waters of the U.S., COTP may establish a security zone, consisting of whatever sections of water and land deemed necessary. No person or vessel may enter this zone or leave any article on a vessel or facility in this zone without COTP (or designee) approval. Any vessel, facility or person in this zone may be inspected or searched, and items or persons may be removed from the zone as deemed necessary. Guards may be posted on any vessel or anywhere in a security zone deemed necessary. Movements of vessels may be controlled as necessary, and within the territorial seas of the U.S., the COTP may enlist the aid and cooperation of Federal, State, county, municipal, and private agencies to assist.

Licenses and required documentation may be required by the COTP for personnel entering a waterfront facility, who may revoke/not approve such based on deciding that the person is a security risk. An appeals process is set up, as is a board to hear such consisting of a Coast Guard Officer and members from company management and a labor representative.

C3-3
DESIGN AND SAFETY STANDARDS
APPLICABLE TO NATURAL GAS
PROJECTS

DESIGN AND SAFETY STANDARDS APPLICABLE TO NATURAL GAS PROJECTS

Documents Incorporated by Reference into Title 49 CFR Part 192, Appendix A, as amended through June 14, 2004		Title (applicable edition)
A. American Gas Association (AGA)		
(1)	AGA Pipeline Research Committee, Project PR-3-805	A Modified Criterion for Evaluating the Remaining Strength of Corroded Pipe (AGA-PR3-805-1989).
B. American Petroleum Institute (API)		
(1)	API Specification 5L	Specification for Line Pipe (42nd edition, 2000).
(2)	API Recommended Practice 5L1	Recommended Practice for Railroad Transportation of Line Pipe (4th edition, 1990).
(3)	API Recommended Practice 5LW	Transportation of Line Pipe on Barges and Marine Vessels (2 nd edition, 1996)
(4)	API Specification 6D	Specification for Pipeline Valves (Gate, Plug, Ball, and Check Valves) (21st edition, 1994).
(5)	API Standard 1104	Welding of Pipelines and Related Facilities (19th edition, 1999, including its October 31, 2001 errata).
C. American Society for Testing and Materials (ASTM)		
(1)	ASTM Designation A 53/A53M-99b	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless (ASTM A53/A53M-99b).
(2)	ASTM Designation A 106	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service (ASTM A106-99).
(3)	ASTM Designation A 333/A 333M	Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service (ASTM A333/A333M-99).
(4)	ASTM Designation A 372/A 372M	Standard Specification for Carbon and Alloy Steel Forgings for Thin-Walled Pressure Vessels (ASTM A372/A372M-1999).
(5)	ASTM Designation A 381	Standard Specification for Metal-Arc-Welded Steel Pipe for Use With High-Pressure Transmission Systems (ASTM A381-1996).
(6)	ASTM Designation A 671	Standard Specification for Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures (ASTM A671-1996).
(7)	ASTM Designation A 672	Standard Specification for Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures (ASTM A672-1996).
(8)	ASTM Designation A 691	Standard Specification for Carbon and Alloy Steel Pipe, Electric-Fusion-Welded for High-Pressure Service at High Temperatures (ASTM A691-1998).
(9)	ASTM Designation D638	Standard Test Method for Tensile Properties of Plastics (ASTM D638-1999).

Documents Incorporated by Reference into Title 49 CFR Part 192, Appendix A, as amended through June 14, 2004	Title (applicable edition)
(10) ASTM Designation D2513-1987 applies to §192.283(a)(1)	Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings (ASTM D2513-1987).
(11) ASTM Designation D2513-1999	Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings (ASTM D2513-1999).
(12) ASTM Designation D 2517	Standard Specification for Reinforced Epoxy Resin Gas Pressure Pipe and Fittings (D 2517-2000).
(13) ASTM Designation F1055	Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing (F1055-1998).
D. The American Society of Mechanical Engineers, International (ASME) and American National Standards Institute (ANSI)	
(1) ASME/ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings (ASME B16.1-1998).
(2) ASME/ANSI B16.5	Pipe Flanges and Flanged Fittings (ASME/ANSI B16.5-1996, including ASME B16.5a-1998 Addenda).
(3) ASME/ANSI B31G	Manual for Determining the Remaining Strength of Corroded Pipelines (ASME/ANSI B31G-1991).
(4) ASME/ANSI B31.8	Gas Transmission and Distribution Piping Systems (ASME/ANSI B31.8-1995).
(5) ASME/ANSI B31.8S	Supplement to B31.8 on Managing System Integrity of Gas Pipelines (ASME/ANSI B31.8S-2002)
(6) ASME Boiler and Pressure Vessel Code, Section I	Rules for Construction of Power Boilers (ASME Section I-1998).
(7) ASME Boiler and Pressure Vessel Code, Section VIII, Division 1	Rules for Construction of Pressure Vessels (ASME Section VIII, Division 1-2001).
(8) ASME Boiler and Pressure Vessel Code, Section VIII, Division 2	Rules for Construction of Pressure Vessels: Alternative Rules (ASME Section VIII Division 2-2001).
(9) ASME Boiler and Pressure Vessel Code, Section IX	Welding and Brazing Qualifications (ASME Section IX-2001).
E. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)	
(1) MSS SP44-96	Steel Pipe Line Flanges (MSS SP-44-1996 including 1996 errata).
F. National Fire Protection Association (NFPA)	
(1) NFPA 30	Flammable and Combustible Liquids Code (NFPA 30-1996).
(2) ANSI/NFPA 58	Standard for the Storage and Handling of Liquefied Petroleum Gases (NFPA 58-1998).
(3) ANSI/NFPA 59	Standard for the Storage and Handling of Liquefied Petroleum Gases at Utility Gas Plants (NFPA 59-1998).

Documents Incorporated by Reference into Title 49 CFR Part 192, Appendix A, as amended through June 14, 2004		Title (applicable edition)
(4)	ANSI/NFPA 70	National Electrical Code (NFPA 70-1996).
G. Plastics Pipe Institute (PPI)		
(1)	PPI TR-3/2000	Policies and Procedures for Developing Hydrostatic Design Bases (HDB), Pressure Design Bases (PDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials (PPI TR-3/2000-Part E only, "Policy for Determining Long Term Strength (LTHS) by Temperature Interpolation."
H. National Association of Corrosion Engineers International (NACE)		
(1)	NACE Standard RP-0502-2002	Pipeline External Corrosion Direct Assessment Methodology (NACE RP-0502-2002).
I. Gas Technology Institute (formerly Gas Research Institute (GRI)		
(1)	GRI 02-0057	Internal Corrosion Direct Assessment of Gas Transmission Pipelines—Methodology (GRI 02/0057-2002).

DETERMINATION OF HIGH CONSEQUENCE AREAS

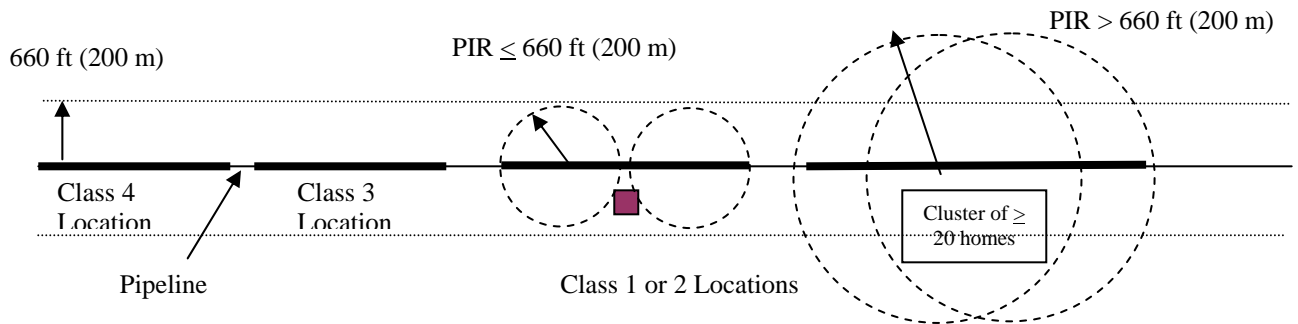
HCA's must be determined using one of two allowable methods described in 49 CFR 192.903, using the process for identification described in 49 CFR 192.905 and guidance provided in an advisory bulletin (68 FR 42456, July 17, 2003). The length of the pipeline subject to pipeline integrity assessments and mitigation actions – the pipeline segment encompassed by the HCA – is also shown in these figures.

Where a potential impact circle is calculated using either Method 1 or Method 2 to establish an HCA, the length of the HCA extends axially along the length of the pipeline from the outermost edge of the first potential impact circle that contains either an identified site or 20 or more buildings intended for human occupancy to the outermost edge of the last contiguous potential impact circle that contains either an identified site or 20 or more buildings intended for human occupancy.

The regulations also allow operators to prorate the number of buildings within an impact circle until 2006. This exemption was intended to relieve the data collection burden on operators of existing pipelines but should not be applied to the new pipeline construction proposed for this Project. Pipeline operators are not required to use the same method along the entire length of any pipeline.

Method 1. HCAs are defined in 49 CFR 192.903 as an area defined as:

- (i) A Class 3 location, or (ii) A Class 4 location, or
- (iii) Any area in a Class 1 or Class 2 location where the potential impact radius is greater than 660 feet (200 meters), and the area within a potential impact circle contains 20 or more buildings intended for human occupancy (unless the exception in paragraph 4 applies), or
- (iv) The area within a potential impact circle containing an identified site.

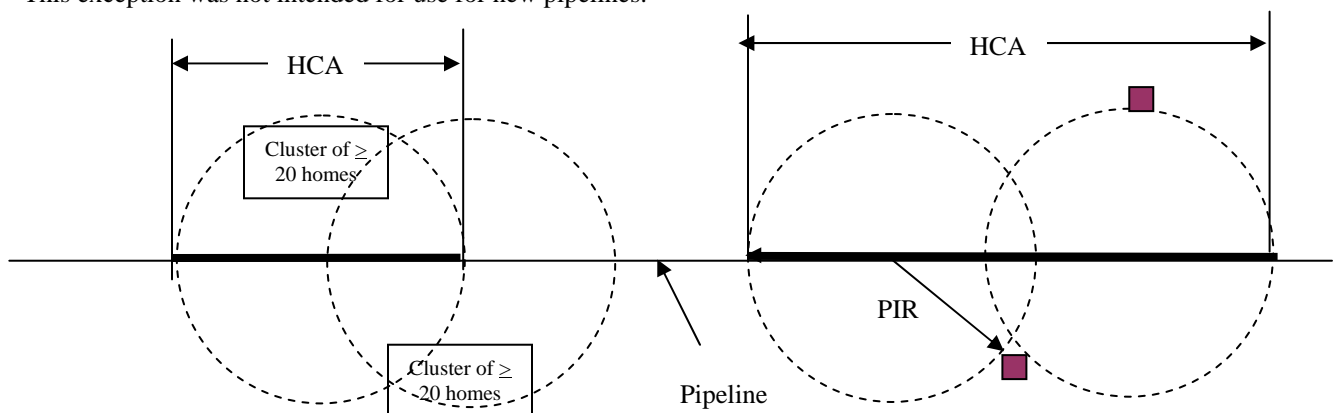


Example of High Consequence Areas using Method 1

Method 2. The area within a potential impact circle containing:

- (i) 20 or more buildings intended for human occupancy, unless the exception in paragraph (4) applies; or
- (ii) An identified site.

Paragraph (4) Exception: If the radius > 660 feet (200 m), the HCA may be identified based on a prorated number of buildings intended for human occupancy within 660 ft from the centerline of the pipeline until December 17, 2006. This exception was not intended for use for new pipelines.



Example of High Consequence Areas using Method 2